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Book Reviews

Phytochemicals for pest control, ed. P. A. Hedin, R. M. Hollingworth, E. P. Masler, J. Miyamoto & D. G. Thompson, American Chemical Society, Washington DC, USA, 1997, x + 372 pp., price US $109.95.
ISBN 0 8412 3488 4

This book, ACS Symposium Series No 658, is developed from a symposium sponsored by the ACS Division of Agrochemicals at the 1995 International Chemical Congress of Pacific Basin Societies, held in Honolulu.

An introductory overview paper outlining the scope of the book is followed by four sections: (1) Identification and utilisation of biologically active natural products, (2) Novel natural products with applications for pest management, (3) Structure–activity studies of natural-product pest-control agents, (4) Biologically active proteins and peptides affecting insects, totalling in all 25 papers.

Recent successes in developing new crop protection chemicals from bioactive natural products continue to stimulate research in this area. This activity is supported by accelerating advances in methodology for the isolation and identification of, often minor component, active chemicals, although problems of scaling up by synthesis or microbial fermentation remain.

Section (1) covers the isolation of chemicals of interest from tropical plants and tropical timbers, including two papers on botanicals from the meliaceae and piperaceae and their insecticidal properties. The section is rounded off with a comprehensive paper on the role of lignans and isoflavanoids in plant defence systems and a specific example involving the isolation from *Ginkgo biloba* of trilactone terpenes with insecticidal activity towards various arthropods, including resistant brown planthopper.

Section (2) begins with an intriguing account of the natural chemicals that act as host recognition signals to trigger pathogenesis, a possible system for chemical disruption. As a fertile field in the search for new insecticides and anti-tumour agents, more than 1000 annonaceous acetogenins, potent inhibitors of ubiquinone-linked mitochondrial oxidases, are predicted to exist in Annona sp. and await isolation in the coming years. A mixture of spinosyns A and D (Spinosad) is being developed for the control of lepidopterous pests on cotton and vegetables. These macrolides, 23 of which have now been isolated, are produced by the actinomycete *Saccharopolyspora spinosa* and the large-scale fermentation of selected mutants of *S. spinosa* now makes many minor component spinosyns available in gram quantities.

Leads to new chemical pesticides may be provided by natural products which show potent activity in laboratory tests but have little practical value due to unfavourable pharmacokinetics or intrinsic instability. Papers in section (3) provide classical examples of the exploitation of such leads in the development of, *inter alia*, anticholinesterase insecticides, juvenile hormone analogues (juvenoids), synthetic pyrethroids, insecticidal pyrroles, the recent neonicotinoids (imidacloprid), the first commercialised nonsteroidal ecdysone agonist and the methoxyacrylate-type fungicides. Recent modifications of the avermectins and milbemycins are also described, in the search for molecules active against specific target insects, mites and nematodes. Ideas for new, selective herbicides arise from studies of host-specific fungal toxins such as those produced by *Alternaria kikuchiana*, which causes black spot disease in Japanese pear. The biological activity of complex molecules may require the intact molecular skeleton but activity can be varied by modification of peripheral substituents, as in the case of Soraphen $A_{1\alpha}$, isolated from myxobacterium *Sorangium cellulosum*, for which such modifications have afforded molecules more fungitoxic than the parent molecule.

It is pleasing to note (section 4) that the tireless pursuit of the structure of the *Bombyx mori* PTTH, the brain neuropeptide that regulates the production of ecdysone, has borne fruit. In order to be usable as control agents, such peptides have to be modified to penetrate insect cuticle or gut wall and to resist enzymatic degradation. The changes necessary are discussed in relation to peptide hormones regulating pheromone production, oviduct contraction, digestive enzyme release, egg diapause and larval pupariation. The ideal approach is to design non-peptide analogues mimicking the conformation adopted by the active peptide at the receptor site and progress is being made in this direction. Peptide hormones such as insect adipokinetic hormones (AKH) are released by the programmed enzymatic breakdown of larger precursors; specific

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inhibitors of the enzymes involved might offer a new approach to insect control. Proteolytic enzymes are involved in many aspects of insect development and metabolism, so that specific inhibitors for, e.g. midgut proteinases, may have devastating effects on larval development.

The last two papers, on cholinergic receptors, will stimulate students of ion-channel structure. In particular, that on the interaction of philanthotoxins (from the wasp, *Philanthus triangulum*) with the nicotine acetylcholine receptor, discusses this receptor in detail and offers thought-provoking ideas about the way these fascinating toxins bind in the associated cation channel.

The information is well presented and referenced, with author, affilation and subject indexes. The book well demonstrates the ingenuity employed in the search for modern pest control agents. There is a wealth of detail to up-date those engaged in basic research, with suggestions for as yet unexplored molecular targets which will provide ideas for others seeking new and environmentally compatible agents for integrated pest/crop management systems.

G. T. Brooks

Crop protection agents from nature: natural products and analogues, ed. Leonard G. Copping, The Royal Society of Chemistry, Cambridge, for the SCI, 1996, xvii + 501 pp., price UK £129.50.
ISBN 0-85404-414-0

This book is Volume 35 of the Society of Chemical Industry's series of Critical Reports on Applied Chemistry. There can be few more fascinating intellectual stimulants than the activities that surround the isolation and identification of useful bioactive chemicals from natural sources. Rapid screening methods combined with modern separative and physicochemical techniques have accelerated the process enormously in recent years, but there still remains the final challenge for the synthesis chemist to develop often extremely elegant total syntheses for structural confirmation and for production purposes.

About half the book (Ch. 1–5) deals with bioactive chemicals from microbial sources, the centre portion with bioactives from higher plants (Ch. 6–8), Ch. 9 with venoms and toxins mainly as leads for insecticides, and the remainder (Ch. 10–14) with biopesticides and regulatory matters. Chapter 1 demonstrates the complexity of the subject. It is a thoughtful introduction which tabulates bioactive secondary metabolites in terms of the taxonomic position of the producing organism, the chemical classes of the metabolites produced and their mode of action, with specific mention of an insecticide (avermectin), a fungicide (validamycin), a herbicide (phthoxazolin) and a nematocide (*trans*-2-decenedioic acid), as examples of the discovery process. Further examples of antifungal, antibacterial, insecticidal and herbicidal compounds are given in Ch. 2, which also discusses molecular biological applications of the genes conferring resistance to the rice fungicide blasticidin S and the herbicide bilanofos.

Chapter 3 is a fascinating, detailed account of the parallel researches at BASF and ICI, which led from the antifungal natural product strobilurin A, isolated from *Strobilurus tenacellus*, to new, broad-spectrum synthetic fungicides. Chapter 4, entitled 'Phytotoxins of Microbial Origin with Potential for use as herbicides', tabulates known modes of action and chemical classes and concludes that the potential for future discovery in this area is enormous. The extraordinary potential of algae as sources of bioactive compounds is expounded at length in Ch. 5, which has 177 chemical structures, 612 references and extensive tabular material in support. For reasons discussed in the Conclusions, algae are a largely untapped source of pharmaceuticals and/or agrochemicals.

Chapter 6 has the overall title of 'Pesticides from Nature' and is subdivided into Part I—an overview of crop protection agents from higher plants, Part II—studies from China on Plants as Sources and Models of Insect control Agents and a short part III, which serves both as a summary of what has gone before and an introduction to Michael Elliot's tour-de-force (Ch. 7) entitled 'Synthetic Insecticides related to the Natural Pyrethrins', which, fittingly, occupies the centre of the book. This is the now classical example of what can be achieved by the patient exploration of a natural product lead and the narrative style of this presentation makes it compelling reading.

Next come 'Natural Defence Mechanisms of Plants' and 'Animal Venoms and Insect Toxins as Lead Compounds for Insecticides' (Ch. 8 and 9, respectively). Chapter 8 begins with secondary metabolites having potential broad-spectrum protective effects against both pathogens and predators, moves on to chemicals acting more specifically against each of these groups, and thence into induced responses, including phytoalexins (which are tabulated) and concludes with a discussion of the mechanisms in plant responses to infection and predation.

Perhaps on account of primeval fears, a certain fascination attends the subject of toxins, which are reviewed species by species, with their poisoning symptoms, in Ch. 9. There are undoubtedly leads here for new syntheses, although the major use of many of these chemicals is in neuroscience research. The problems for toxins as control agents lies in getting them to the molecular sites of action within target organisms. Ingenuity can overcome these problems, as illustrated in Ch. 10, 'Diversity and Biological Activity of *Bacillus thuringiensis*' and Ch. 11 'Natural and Engineered Viral Agents for Insect Control'. Together, these chapters